[Proc. Roy. Soc. Victoria, **55** (N.S.), Pt. II., 1943.]

Art. VII.—*The Genus Lepidocyclina in Victoria.*

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[Read 13th August, 1942; issued separately 1st October, 1943.]

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Abstract.

The systematic study of the genus *Lepidocyclina* in the Victorian Tertiary sediments, shows that it is represented by the subgenus *Trybliolepidina* which is characteristic of the upper Middle Miocene and Upper Miocene in the Indo-Pacific region. Three species occur, viz., *L.* (*T.*) *batesfordensis* sp. nov., *L.* (*T.*) *howchini* Chapman and Crespin and *L.* (*T.*) *gippslandica* sp. nov. The *Lepidocyclina* horizon in Victoria is placed near the boundary between the Burdigalian and Vindobonian stages in Europe.

Introduction.

The genus *Lepidocyclina* was instituted by Gümbel in 1870, and belongs to the group of orbitoidal foraminifera which is of considerable importance in the zoning of the Tertiaries in all parts of the world. It is abundantly represented in the Miocene in the Indopacific region, which includes Australia. The species of *Lepidocyclina* found in the Miocene deposits of Western Australia are referable to those recorded from the Netherlands East Indies, Papua and New Guinea, but the Victorian forms suggest the presence of an embayment in South-Eastern Australia in which other species, but still with Indopacific affinities, flourished. Further support to this theory is given by the molluscan species, which are distinct from those recorded from Western Australia where the affinities are definitely Indopacific. This applies both to Pliocene and Miocene species. Other foraminiferal genera in Victoria with similar tendencies include *Cycloclypeus*, the species

of which show relationship with *C. indopacifica* Tan, and *Austrotrillina howchini* (Schlumberger). This latter form, originally described from Clifton Bank, Muddy Creek, Hamilton, Victoria, has been found in only two other localities in the State, namely, the Mallee Bores and at Skinner's section, Mitchell River, Gippsland. The common Indopacific Middle Miocene genera *Miogypsina* and *Flosculinella* have not been found in Victoria.

Lepidocyclina is developed in three separate areas in Victoria. (1) In Western Victoria at Clifton Bank, Hamilton, and in the Hamilton Bore, where numerous tests are present in the samples from 30 feet down to 230 feet. (2) South Central Victoria in the Port Philip Basin, where rich *Lepidocyclina* limestone deposits occur at Batesford, Keilor, and Flinders. The genus is also present in bores in this area. (3) East Gippsland in outcrops and numerous borings. These occurrences will be discussed in Section 6.

Previous Literature on the Victorian Lepidocyclinae.

The Orbitoids were first recognized in Victoria by the late Professor Howchin, who, in 1889, referred to them as *Orbitoides dispansus, O. mantelli* (Morton) and *O. stellata* Howchin from Hamilton.

In 1891, Hall and Pritchard recorded *O. mantelli* from the Batesford quarries near Geelong.

In 1904, Lémoine and Douvillé proved that the forms described by Howchin as *Orbitoides* belonged to the Eocene to Miocene genus *Lepidocyclina.*

In 1910, F. Chapman published his paper on "A Study of the Batesford Limestone," in which he listed three species of Lepidocyclinae—*L. marginata, L. martini* and *L. tournoueri.* He also identified a species from Green Gully, Keilor, and from Hamilton as *L. verbeeki.* In 1914 the same author reviewed the various Victorian *Lepidocyclina* localities in his "Homotaxial Relationship of the Australian Cainozoic System."

In 1925, Chapman and Singleton referred to the presence of *Lepidocyclina tournoueri* and *L. martini* in the Middle Miocene bryozoal limestones of Victoria.

In 1926, the writer listed five species of *Lepidocyclina* from vertical sections in a limestone from Green Gully, Keilor—*L. tournoueri, L. marginata, L. martini, L. verbeeki,* and *L.* (*Eulepidina*) *murrayana.*

In 1930, Chapman and Crespin recorded *L.* (*Nephrolepidina*) *borneënsis* and *Cycloclypeus communis* from borings in Victoria. In 1932, they listed five species of *Lepidocyclina* including two

new forms *L. hamiltonensis* and *L. howchini* as well as *Spiroclypeus margaritatus* from the Victorian Tertiaries. Other species recorded were *L. martini*, *L. radiata* and a trigonolepidine form, *L. sumatrensis* forma *mirabilis*. Also in 1932, they zoned the "Lower Miocene" beds in borings in Gippsland on the presence or absence of *Lepidocyclina* and *Cycloclypeus*.

In 1936, the writer listed eleven species of *Lepidocyclina* and one of *Cycloclypeus* from Victoria.

During recent years, palaeontological reports on material from borings in the Tertiary rocks of Victoria have been made by the Geological Branch of the Department of the Interior, Canberra, now the Mineral Resources Survey Branch of the Department of Supply and Shipping, on behalf of the Victorian Mines Department and private companies engaged in the search for oil. These reports contain records of the occurrence of *Lepidocyclina*, which are herein made available for publication for the first time.

Remarks on Previously Recorded Species.

Prior to the present investigation the following species of *Lepidocyclina* were recorded from the Victorian beds:—

Lepidocyclina (*Nephrolepidina*) *angulosa* Provale.
L. (*N.*) *borneënsis* Provale.
L. (*N.*) *hamiltonensis* Chapman and Crespin.
L. (*N.*) *howchini* Chapman and Crespin.
L. marginata (Michelotti).
L. (*N.*) *martini* Schlumberger.
L. (*Eulepidina*) *murrayana* Jones and Chapman.
L. (*N.*) *radiata* (Martin).
L. (*N.*) *sumatrensis* (Brady).
L. (*N.*) *sumatrensis* (Brady) forma *mirabilis*.
L. (*N.*) *tournoueri* Lémoine and Douvillé.
L. verbeeki Newton and Holland.

In 1939 the writer was privileged to visit the Netherlands East Indies to study with Dr. Tan Sin Hok of the Geological Museum, Bandoeng, Java, the relationship of the *Lepidocyclinae* of that country with those of Australia, Papua and New Guinea. The results of this investigation and further intensive research on hundreds of Victorian specimens are—(1) that the number of species present in Victoria is three, one of which is the already described form *L. howchini*, the other two being new and now designated *Lepidocyclina* (*Trybliolepidina*) *gippslandica* and *L.* (*T.*) *batesfordensis*, and (2) that the records from Victoria of species originally described from outside Australia are incorrect.

The study of the Victorian *Lepidocyclinae* reveals three outstanding characteristics:—

(*a*) All specimens exhibit polygonal features.

(*b*) All megalospheric specimens examined belong to the subgenus *Trybliolepidina* and not to *Nephrolepidina* as previously considered.

(*c*) The median chambers in both megalospheric and microspheric specimens are chiefly ogival to spatulate in shape, hexagonal ones being sometimes present in the rayed portion of the test.

It is these features which exclude from the Victorian assemblage such species as *L.* (*N.*) *tournoueri*, *L.* (*N.*) *borneënsis* and *L. marginata*. All microspheric specimens have been previously recorded as *L. marginata*, a species in which the median chambers pass from ogival to hexagonal. In the Victorian specimens they are ogival around the protoconch, becoming spatulate to elongate-spatulate towards the margin of the shell. The majority of specimens in horizontal section show a tendency to be strongly rayed for a short distance out from the protoconch.

L. tournoueri is nephrolepidine and non-polygonal, with the median chambers typically hexagonal in shape. The species is rare in the Indopacific being probably replaced by *L. borneënsis* Provale. Chapman recorded *L. tournoueri* as the most abundant species in the bryozoal limestone at the Filter Quarry, Batesford. The dominant form there is gently biconvex, and slightly polygonal in outline; the median chambers are typically ogival to spatulate and the embryonic and nepionic apparatus is trybliolepidine. The species is now referred to as *L.* (*T.*) *batesfordensis*.

L. borneënsis, which is apparently the Indopacific representative of *L. tournoueri* is also non-polygonal and nephrolepidine and does not appear in Victoria. Specimens recorded as *L. angulosa* and *L. sumatrensis* are merely fractured tests of *L.* (*T.*) *gippslandica* or *L.* (*T.*) *howchini*, all gradations of fracture being available especially in the Gippsland populations. The specimens listed as *L. murrayana* are abnormal forms of *L.* (*T.*) *gippslandica* or *L.* (*T.*) *batesfordensis*. *L. sumatrensis* forma *mirabilis* is included here. All specimens previously referred to as *L. radiata* now belong to *L.* (*T.*) *gippslandica*. Martin's description (1880) of the external features of *L. radiata* is applicable to this new species. "Test flat, 8 mm. in diameter, very thin, furnished in the centre with a thick, button-like elevation. From this, nine rays run towards the periphery. These rays are sharply distinguishable from the flat, extended part of the test, lying between them; they are single for their entire extent and end close to the periphery. Between each pair of rays the border of the test is always scalloped once. The surface shows a series of very

fine discontinuous ridges, parallel with the outer edge. Nothing is known of the inner structure. There the rays of the fossil neither bifurcate nor reach the edge. Occurrence of single specimen—Sindangbarang, Preanger, Java." It is unfortunate that the type description is based on the external characters of a single specimen, which is housed in the Leiden Museum, Holland. Nothing is known of the internal structure, but Tan, who has seen the specimen, suspects that it is Trybliolepidine or Cyclolepidine. Until recently *L. radiata* was considered as belonging to "e" stage (Lower Miocene), but it is now known (communication from Tan) that "it must have been derived from the young Tertiary (Young Miocene) Bantang Series of Southern Preanger." Tan had hoped to collect from the type locality but present conditions have prevented this. It is this dearth of information regarding the true characters of *L. radiata* that makes it unsafe to refer to it as a basic species.

The specimens which have been recorded as *L. martini* belong partly to *L.* (*T.*) *gippslandica* and partly to *L.* (*T.*) *howchini*. It is known that *L. martini* is a trybliolepidine but the shape of the median chambers in the rayed portion of the test is hexagonal, whilst in the Victorian specimens, especially in *L.* (*T.*) *gippslandica* and *L.* (*T.*) *howchini*, it is typically elongate spatulate. Schlumberger's description (1900) of the external features of *L. martini* is as follows "Shell star-shaped, thickened at the centre, thinned towards the margin, furnished on the rim with six to eight prominent rays, some sharpened others more or less tongue-shaped. The surface of well preserved individuals has some small granulations at the centre." The type locality is Batoe Koetjing, Madoera. *L.* (*T.*) *howchini* has six to eight blunt rays and usually the surface is rather smooth, although some specimens have a few strong pustules towards the centre of the shell. Specimens referred to as *L. verbeeki* were chiefly from the Hamilton Bore. These are now included under *L.* (*T.*) *batesfordensis*.

Systematic Study of the Genus.

Consideration of the Embryonic and Nepionic Apparatus.

Megalospheric Generation.

The division of the Lepidocyclinae into subgenera was originally based on the arrangement of the embryonic (initial) chambers, but in recent years the study of the nepionic (auxiliary) chambers is considered of equal importance.

In 1904 Lémoine and R. Douvillé recognized two different types of embryonic apparatus and also distinguished between the microspheric and megalospheric forms. H. Douvillé, in 1911, instituted the terms *Nephrolepidina* and *Eulepidina* for these two types. In 1924, he added two more subgenera, namely *Isolepidina*

and *Amphilepidina*, the former being based on the structure of the embryonic apparatus and the latter, not only on the shape of this apparatus but also on that of the median chambers. In 1928, Van der Vlerk created the new subgenus *Trybliolepidina*, Galloway in 1933 designating as its type species Van der Vlerk's *L. rutteni*, described in 1924 from Tji Boerial, Preanger, Java. Van der Vlerk considered this subgenus an important index group indicating the top of stage "f" or Upper Miocene. Gerth, in 1930, stated that "As species of *Lepidocyclina* which show a transition from the *Nephrolepidina*-stage to the *Trybliolepidina*-stage have already been found in the older Miocene, the occurrence of *Trybliolepidina* is not a true indication for the younger Miocene. But if *Trybliolepidina* is only found without true *Nephrolepidina*, it is very probable that beds of the younger Miocene have to be dealt with." He considered the "older Miocene" as Burdigalian, the "younger Miocene" as Vindobonian. In the same year Tan pointed out that not the subgenus *Trybliolepidina* but some of its species are stratigraphically important. Vaughan and Storrs Cole (in Cushman 1940) considered that the subgenus should not be recognized their reasons being based on Caudri's work in 1939.

Recent investigations on material from bore section and outcrops in North-west Australia, Papua and New Guinea indicate that this subgenus is of definite stratigraphic value. The stratigraphically highest *Lepidocyclina* to be met with in these areas always belongs to the subgenus *Trybliolepidina*.

The outstanding feature of the study of crowds of Victorian specimens is the persistence of the type of nepionic apparatus, which has one or two nepionic chambers fewer than *L.* (*T.*) *rutteni*, the species upon which *Trybliolepidina* is based, and two or three more than in *Nephrolepidina*. The shape of the embryonic apparatus is practically uniform in all sections, the large protoconchal chamber partially embracing the smaller deuteroconchal one.

In discussing the median section of a megalospheric *Lepidocyclina* a certain convenient terminology is used. It was introduced by Henbest (1934) and later developed by Tan (1935).

1. The embryonic or initial apparatus refers to the two most central chambers, the protoconch (P) and the deuteroconch (D). The way in which the deuteroconch embraces the protoconch differs according to the subgenus.

2. The primary stolons are the connecting links between the protoconch and the deuteroconch. They are of two kinds—(*a*) the protoconchal stolons which links the two embryonic chambers, and (*b*) the deuteroconchal stolons which link the deuteroconch with the (nepionic) chambers which immediately surround it.

3. The nepionic chambers are the auxiliary chambers found immediately on the external wall of the embryonic apparatus. They are of two kinds—(*a*) the primary auxiliary chambers (P) which are two in number and overlap the junction between the protoconchal and deuteroconchal chambers, and (*b*) the adauxiliary chambers (Ad) which are attached to the external wall of the deuteroconch, being developed from the deuteroconchal stolons. They vary in number according to the subgenus. Six are the characteristic number in the Victorian specimens. They are absent in the subgenus *Eulepidina*.

4. The nepionic stolons are two in number and are produced from the nepionic chambers on either side of the frontal wall. They are called posterior and anterior. They are frequently difficult to see in sections.

5. The neanic stage is the series of budding immediately surrounding the nepionic chambers, being an intermediate stage between the embryonic apparatus and the cyclic chambers which continue until the shell has completed growth.

The structure of the embryonic and the nepionic apparatus in the Victorian Lepidocyclinae is illustrated in Fig. 1. Fig. 1A represents a median section through a megalospheric specimen of *L.* (*T.*) *batesfordensis* from the old Filter Quarry, Batesford. Fig. 1B is of a specimen of *L.* (*T.*) *gippslandica* from No. 5 Bore, Parish of Gleneoe, Gippsland. Both sections were cut and the structural features indicated under the supervision of Dr. Tan Sin Hok.

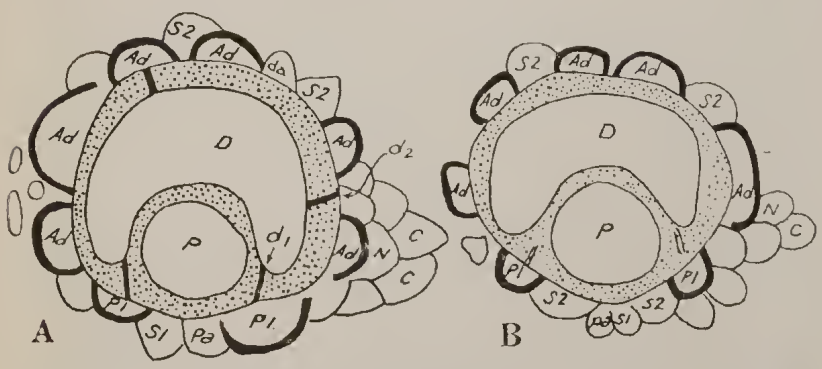

FIG. 1.—P, protoconch; D, deuteroconch; Pl, primary auxiliary chambers; Ad, adauxiliary chambers; S1, S2, symmetric nepionic chambers; pa, asymmetric nepionic chambers; da, asymmetric deuteroconchal chambers; N, neanic stage; C, cyclic chambers; d1, primary stolons; d2, stolons linking deuteroconch with adauxiliary chamber.

It will be noticed that the embryonic apparatus consists of two chambers—the protoconch (P) which is partly embraced by a larger chamber, the deuteroconch (D). The outer wall of the

embryonic apparatus is thick, a persistent feature of the trybliolepidine type. Four deuteroconchal stolons are seen in the Batesford specimen but none is visible in the Glencoe form. Two primary stolons (d_1) link the deuteroconch with the primary auxiliary chambers just at the point where the deuteroconchal wall meets the protoconch. Two other deuteroconchal stolons (d_2) are visible passing through the deuteroconchal wall into adauxiliary chambers. Surrounding the external wall of the embryonic apparatus in the Batesford species are eight nepionic chambers, which represent budding periods. Two primary auxiliary chambers (pa) overlap the point where the protoconchal and deuteroconchal walls meet, while six adauxiliary chambers (Ad.) bud off from the external wall of the deuteroconch. This number is fairly uniform in the Victorian specimens. In the Batesford population there are variations from 5 to 8 with 4 very rare. In *L.* (*T.*) *rutteni,* they vary from 6 to 11. In *L.* (*T.*) *gippslandica* adauxiliary chambers are present with 4 to 6 being the most constant. Three specimens showed 3, which suggests Nephrolepidine ancestry.

In all sectioned specimens, the chambers constituting the juvenarium are ogival in shape.

Microspheric Generation.

The structure of the embryonic apparatus of all microspheric forms of *Lepidocyclina*, whether nephrolepidine or trybliolepidine, is fairly constant. In the Victorian specimens, there is a large initial chamber which is surrounded by six smaller initial ones arranged in a single spiral. The polygonal arrangement of the median chambers is not apparent until four spirals of larger chambers have been developed. The plani-spiral arrangement of the microspheric nucleoconch is constant in all genera of the Orbitoididae, the specific determinations being made on the shape of the median chambers.

Workers on the Lepidocyclinae in Europe and the Netherlands East Indies have, for the most part, given definite specific names to microspheric forms without regard to the megalospheric species to which they may be related. This method of nomenclature is incorrect when the microspheric generation occurs with a population of megalospheric specimens all of which can be referred to the one species. Such is the case in the Upper Quarry at Batesford, where parts of the limestone are made up almost entirely of tests of megalospheric and microspheric examples of a single species of *Lepidocyclina*, and similarly in the Gippsland bores. As a result, in this work, the microspheric form is referred to as " Form B " of the species with which it is closely associated.

Description of Species.

LEPIDOCYCLINA (TRYBLIOLEPIDINA) GIPPSLANDICA sp. nov.
(Plate III., figs. 1-7; Plate VI., figs. 22-28.)

FORM A.

Lepidocyclina (*Nephrolepidina*) *radiata* Chapman and Crespin (non Martin), 1932, p. 95, pl. xiii., figs. 15-17.

Lepidocyclina (*Nephrolepidina*) *martini* Chapman and Crespin pars (non Schlumberger), 1932, pl. xii., figs. 11-14. Crespin, 1936, p. 10, pl. ii., figs. 25, 26.

External characters of holotype.—Test with polygonal outline. Surface smooth except for 9 pustules on central boss. Nine rays extend from central portion towards periphery, where they flatten out and do not protrude beyond edge. Median chambers seen towards edge of shell. Diameter of test—5 mm.; thickness at central boss—2 mm.

Internal characters of tectotype.—(*a*) Median Section. On account of the wavy nature of the test, it is difficult to obtain perfect sections. Median chambers thin walled, arranged in polygons, with narrow rays which commence a short distance out from the embryonic apparatus, and broaden out towards margin. Chambers in rays chiefly elongate spatulate, rarely hexagonal. Chambers immediately surrounding nepionic apparatus ogival and between rays pass from ogival to spatulate towards periphery. Embryonic apparatus trybliolepidine, with 7 nepionic chambers. Outer wall of protoconchal and deuteroconchal chambers thick. Width of protoconchal chamber 0·16 mm., deuteroconchal 0·33 mm.

(*b*) Vertical section. Test biconvex. Lateral chambers rounded, showing curved horizontal walls; thin walled, 9 layers; strong pillars in central portion.

Locality of holotype and tectotypes.—No. 5 Bore, P. of Glencoe at 70 feet (Com. Pal. Coll. Nos. 39 and 212).

Paratypes.—(*a*) No. 15 Bore, P. of Stradbroke at 45 feet. External characters similar to holotype. Polygonal outline pronounced, 9 rays showing thickening and broadening towards periphery. Surface slightly pustulate, due to weathering of specimen. Central pustules strong. Diameter—5 mm.; thickness at central boss—2 mm.

(*b*) Locality as (*a*). Test rayed, with 10 flattened rays protruding beyond edge of shell, due to fracturing of test between rays. Surface rough, central boss pustulate. Diameter—4 mm.; thickness at centre 1·5 mm .

(*c*) Skinner's Section, Mitchell River, P. of Wuk Wuk. Test fractured but 8 flattened rays visible. Surface slightly roughened with weathering. Pustules on central boss. Diameter—5 mm.; thickness 2 mm.

Observations.—As previously stated, perfect specimens of *L.* (*T.*) *gippslandica* exhibit the external features of *L. radiata* Martin, as well as intergradations between Scheffen's form *L.* (*T.*) *rutteni* forma *globosa* and *L. martini* Schlumberger. In horizontal section the persistent shape of the median chambers which range from ogival to spatulate, with occasional tendency to hexagonal in the rayed portion prevents the species being classed with *L. martini.* In vertical section the species is closely comparable with *L.* (*T.*) *rutteni* forma *globosa* not only in the general outline but in shape of the lateral chambers which are rounded rather than rectangular. In the horizontal direction, the similarity is in the structure of the embryonic apparatus, which shows 4 adauxiliary chambers. In *L.* (*T.*) *gippslandica* the number varies from 4 to 5. Two specimens had 6 and two had 3. The main difference is that in *L.* (*T.*) *rutteni* forma *globosa,* the rays are 5 in number, and strongly developed, the chambers in that region being typically hexagonal.

L. (*T.*) *gippslandica* is the predominant species in the Gippsland borings and outcrops. The majority of specimens are small averaging about 3·5 mm. in diameter. This slight variation from the size of the type is due to the fracturing of the margin of the test to a distance fairly close to the central portion. In populations such as are found in No. 5 Bore, P. of Glencoe, at 70 feet, in No. 15, P. of Stradbroke at 45 feet, and in Brock's Quarry, the gradual gradation from perfect specimens as exhibited in the type specimen, to those smaller fractured ones, such as predominate the populations, can be well studied, and it is only by such study that the existence of only one species can be demonstrated.

The species is recorded from the base of the New Quarry at Batesford (collected by F. A. Cudmore) where it is associated with *L.* (*T.*) *batesfordensis,* the main development of the latter species being in the upper beds of the section. In the Gippsland bores *L.* (*T.*) *gippslandica* is always most abundant in the zone where it is associated with *Cycloclypeus victoriensis* var. *gippslandica* Crespin which underlies that in which *L.* (*T.*) *batesfordensis* is recorded. A similar sequence is found in the Hamilton Bore in Western Victoria, where *L.* (*T.*) *gippslandica* is replaced by the smaller rayed form *L.* (*T.*) *howchini,* which is very common below the lowest depth at which *L.* (*T.*) *batesfordensis* is present.

L. (*T.*) *gippslandica* is associated with *Austrotrillina howchini* (Schl.) at Skinner's, as well as with *Hofkerina semiornata* (Howchin), *Planorbulinella inaequilateralis* (Heron-Allen and Earland), *P. plana* (H-A. and E.) and *Gypsina howchini* Chapman, which are always present.

Occurrence.—The localities for the holotype and paratypes have already been listed. Further localities include 56 bores in Gippsland. The shallowest depths from which the species have been recorded are at 45 feet in No. 15 Bore, P. of Stradbroke, and at 50 feet in No. 5 Bore, P. of Glencoe, and the greatest depth in the Holland's Landing Bore, P. of Bengworden South, where it was found at 1,886 feet. Cliff and quarry sections in Gippsland include Skinner's, Mitchell River, P. of Wuk Wuk; E. of Hillside Bridge, North Cliff, Mitchell River, P. of Moormurng; Boggy Creek at Bridge near junction with Mitchell River, P. of Wy Yung (collected by officers of Victorian Mines Department); Brock's and Le Grand's quarries, P. of Glencoe (coll. I.C.). Other localities include New Quarry, Batesford near base of section (coll. F.A.C.).

Form B.

Paratype.—From No. 15 Bore, P. of Stradbroke, Gippsland, at 45 feet. External characters—Specimen with fractured edge, biconvex, with numerous pustules in central portion of test. Diameter—7 mm. Greatest thickness 2 mm. (Com. Pal. Coll. No. 198.)

Internal characters (based on a number of thin sections).—Median section—Microspheric nucleoconch, planispiral, showing circular arrangement of chambers in embryonic apparatus, with further initial chambers arranged in spiral. Arrangement of median chambers polygonal, showing 5 rays, in central portion of test. Chambers ogival in rayed portion passing to spatulate and elongate spatulate towards periphery. Test shows considerable regeneration.

Other paratypes.—(*a*) Brock's Quarry, P. of Glencoe. Test discoidal finely pustulose. Diameter 7 mm.; greatest thickness 2 mm.

(*b*) Same locality.—Test thin with indistinct rays present. Strong pustules in centre but surface covered with smooth concentric bands possibly due to weathering.

Observations.—Microspheric specimens are not common and as a result not many sections were available for study, but all showed similar internal features including the central polygonal arrangement of chambers and the ogival to spatulate median chambers.

The tests are not large, the diameter averaging 6 mm. One unusually large specimen with a diameter of 14 mm. was recorded from No. 7 Bore, P. of Glencoe, Gippsland, at 520 feet.

The rayed character of the central portion is a feature of many of the microspheric forms from the Netherlands East Indies, in

which the median chambers are usually elongate-spatulate to elongate-hexagonal. The Victorian specimens are most closely comparable with *L. stratifera* Tan, in which ogival to spatulate chambers are predominant.

Occurrence.—Localities are as listed under the megalospheric form.

Lepidocyclina (Trybliolepidina) howchini Chapman and Crespin.

(Plate IV., figs. 8-15; Plate VII., figs. 30-35.)

Form A.

Orbitoides stellata Howchin (*non Orbitulites stellata d'Archiac*, 1850), 1888, p. 17, pl. i., figs. 9-11.

Lepidocyclina (*Nephrolepidina*) *howchini* Chapman and Crespin, 1932, p. 94, pl. xiii., figs. 18, 19; Crespin, 1936, p. 8, pl. ii., figs. 17, 18.

Lepidocyclina (*Nephrolepidina*) *hamiltonensis* Chapman and Crespin, 1932, p. 93, pl. xii., figs. 8-10; Crespin, 1936, p. 8, pl. ii., fig. 19.

Lepidocyclina (*Nephrolepidina*) *martini* Chapman and Crespin (non Schlumberger), 1932, pars, p. 95.

Lepidocyclina (*Nephrolepidina*) *radiata* Chapman and Crespin (non Martin), 1932, pars, ibid., p. 96.

Holotype of variety.—Description of *L.* (*T.*) *howchini* as given by Chapman and Crespin. "Description of Holotype (from Hamilton Bore, 80-85 feet).—Test small, discoidal with blunt marginal prolongations. Surface strongly convex, central part of test with a group of strong papillae, smaller on surrounding area. Description of Tectotype.—Vertical section from 68-80 feet. Equatorial series narrow, lateral, chamberlets forming 6 layers superimposed on centrosphere, 5 vertical pillars shown in cross section in the central region. Dimensions.—Diameter of test 2·9 mm.; thickness of test, 1·17 mm. Diameter of centrosphere, 0·14 mm.; longest diameter of nucleoconch, 0·41 mm." (Com. Pal. Coll. No. 42.)

Plesiotypes.—(1) Howchin's locality at Clifton Bank, Muddy Creek, Hamilton. External characters—Test small compressed, discoidal, with 8 blunt marginal prolongations, giving stellate appearance. Surface rough, with 9 strong pustules on central portion. Diameter—3·5 mm.; greatest thickness—1 mm.

Internal characters—Median section. Median chambers thin-walled. Rays not pronounced; chambers chiefly ogival in shape, becoming spatulate towards periphery and in rayed portion. Nepionic apparatus trybliolepidine, with 8 nepionic chambers, comprised of 2 primary auxiliary and 6 adauxiliary, embracing the embryonic apparatus. Outer wall of protonchal and deuteroconchal chambers thick. Width of protoconchal chamber 0·20 mm.; of deuteroconchal 0·39 mm.

(2) Specimen from Flinders. Test small, with ten prolongations; biconvex, with strong pustules in centre, diameter—4 mm.

Observations.—A figure of a median section of *L.* (*T.*) *howchini* is not given by Chapman and Crespin but one is shown under "*L. hamiltonensis.*" The trybliolepidine nucleoconch is present, with 7 nepionic chambers, including 2 primary auxiliary and 5 adauxiliary. The median chambers in the immediate vicinity of the nepionic apparatus are ogival and pass into spatulate, while the elongate-spatulate shape is recognizable in the rayed portion. Howchin's type specimen of "*O. stellata*" cannot be located either in the Geology Department, University of Adelaide, or in the Howchin Collection in the South Australian Museum. Numerous sections of topotypes have been studied, all showing trybliolepidine affinities. At the same time the study of this population at Howchin's type locality shows that "*L. hamiltonensis*" is synonymous with *L.* (*T.*) *howchini*. Perfect sections of this latter form are difficult to secure on account of the mode of preservation of the tests. All specimens from Muddy Creek and throughout the major part of the Hamilton Bore are iron-stained, those from the lower portion of the bore being partially replaced with glauconite.

L. (*T.*) *howchini* is very common at Flinders. It is recorded from the Tyabb Bore, Mornington Peninsula, and at Skinner's section, Mitchell River, Gippsland. It is exceedingly rare in the Gippsland bores. It is usually associated with *Amphistegina* and *Calcarina verriculata* at Hamilton and Flinders.

Tests are invariably small averaging about 3 mm., some of the Flinders specimens reaching 4 mm. The number of blunt prolongations vary from 6 to 8 and rarely 10, while the convexity of the tests is also variable. The surface ornament varies according to preservation, a feature well illustrated in the Flinders specimens which are frequently strongly pustulose.

Occurrence.—Western Victoria. Lower beds, Muddy Creek, Hamilton; throughout the Hamilton Bore down to 187 feet, becoming the predominant species below 80 feet. Port Philip region. Basal beds in New Quarry, Batesford; Water Bore, Avalon, Lara, at 315 feet; Water Bore; Victoria Golf Club, Cheltenham, at 221 feet; No. 1 Bore, Tyabb at 57-90 feet; No. 2 Bore, Tyabb at 173-176 feet; Flinders. Gippsland-Skinner's section, Mitchell River, near Bairnsdale.

Form B.

Lepidocyclina marginata Crespin (non *Nummulites marginata* Michelotti), 1936, p. 9, pl. ii., fig. 21.

Plesiotype.—From Hamilton Bore. External characters from specimen at 91-96 feet. Test discoidal, biconvex, with numerous pustules chiefly on central portion. Diameter 5 mm.; greatest thickness 1·5 mm. (Com. Pal. Coll. No. 202.)

Internal characters of specimen at 86-91 feet. Median section—Embryonic chamber indistinct but surrounded by a single spiral embryonic chamber. This in turn is surrounded by chambers arcuate to ogival in shape. These chambers pass outwards into broadly spatulate ones. Hexagonal chambers rare in outer portion due to spatulate chambers not being sectioned through the centre. Polygonal arrangement only faintly suggested, but is stronger in less perfect sections. Vertical section of specimen at 36-38 feet. Structure indistinct because of ironstaining. Central median chambers thin in centre widening out towards margins of shell indicating polygonal character. Fifteen superimposed lateral layers only the outer 8 being continuous throughout the length of the test. The central ones rise convexly from the central median chamber before converging to it. Pillars in outer central portion of test. Lateral chambers slightly convex.

Observations.—Owing to the mode of preservation (all specimens being ironstained) good sections are difficult to obtain. The microspheric specimens from Hamilton are identical with those from Flinders both in external and internal characters. There is little variation in the size of tests. One Hamilton specimen from 86-91 feet had a diameter of 6 mm.; and another from Flinders, 7 mm.

Occurrence.—At various depths in the Hamilton Bore; Flinders; No. 7 Bore, P. of Parwan, at 316-329 feet.

LEPIDOCYCLINA (TRYBLIOLEPIDINA) BATESFORDENSIS sp. nov.
(Plate V., figs. 16-21; Plates VIII. and IX., figs. 36-46.)

FORM A.

Lepidocyclina tournoueri Chapman (non Lémoine and Douvillé), 1910, p. 295, pl. liv., figs. 1, 2, 6; Crespin, 1926, p. 114, pl. viii., fig. 7; ibid., 1936, pl. ii., figs. 16, 23.

Lepidocyclina verbeeki Crespin (non Newton and Holland), 1926, p. 115, pl. viii., fig. 10.

Lepidocyclina (*Nephrolepidina*) cf. *tournoueri* Singleton, 1941, p. 32.

Holotype.—External characters—Test discoidal, fairly evenly biconvex, with peripheral edge sharp and sometimes wavy. Pustules cover test but are stronger towards central portion. Surface smooth near periphery. Diameter 5 mm.; greatest thickness 1 mm.

Internal characters of tectotype.—(*a*) Median section. Median chambers thin-walled, arranged in polygons, with seven broad rays, extending almost to the margin of the test. Chambers immediately surrounding nepionic apparatus ogival in shape, passing from ogival to spatulate towards the edge of the test. Inter-radial chambers chiefly ogival to broadly spatulate. In radial portion they become elongate spatulate with some hexagonal.

Embryonic apparatus trybliolepidine, with 8 nepionic chambers. Outer wall of protoconchal and deuteroconchal chambers thick. Width of protoconchal chamber 0·27 mm.; deuteroconchal 0·5 mm.

(*b*) Vertical section.—Test biconvex, lateral chambers show slightly curved horizontal thin walls with eleven superimposed layers. Strong pillars in central portion.

Locality.—*Lepidocyclina* limestone, Upper Quarry (Australian Portland Cement Co.), Batesford, near Geelong, collected by Dr. F. A. Singleton. (Com. Pal. Coll. No. 206.)

Paratype.—New Quarry, Batesford (collected by F. Cudmore). Test smaller than holotype but with similar characters. Diameter—3·5 mm. Horizontal section shows similar rayed characters, with ogival to spatulate type of chambers. Nepionic chambers 6.

Observations.—Tests of *L.* (*T.*) *batesfordensis* occur in profusion in certain parts of the Batesford quarries. This species is that referred to *L. tournoueri* by Chapman. Specimens from the Filter Quarry were taken to Java by the writer and examined by Dr. Tan Sin Hok. The photograph of one of his sections is shown in Fig. 36. The arrangement of the embryonic apparatus excluded *L. tournoueri* as the possible species and an examination of a great number of sections excluded the possibility of its being present at Batesford. *L.* (*T.*) *batesfordensis* is typically trybliolepidine and polygonal, with chambers ogival to spatulate. As already stated, *L. tournoueri* is nephrolepidine, non-polygonal, with chambers chiefly hexagonal. In all sections examined the character of the embryonic apparatus is uniform, the number of nepionic chambers varying from 6 to 8. The specimens from the upper part of the New Quarry (collected by F. A. Cudmore) are similar in size to those from the old Filter Quarry; but those from the Upper Quarry (collected by Dr. F. A. Singleton and W. J. Parr) were consistently larger. Unfortunately in all cases, perfect horizontal sections were difficult to obtain owing to the wavy character of the test.

At Batesford *L.* (*T.*) *batesfordensis* is associated with *Cycloclypeus victoriensis* together with abundant *Amphistegina lessonii, Calcarina verriculata, Gypsina howchini, Planorbulinella plana* and *P. inaequilateralis.*

The population at Green Gully, Keilor, is dominated by large specimens of *L.* (*T.*) *batesfordensis,* similar to those from the Upper Quarry at Batesford. It is not common at Flinders but tests are fairly numerous in the upper portion of the Hamilton Bore. It is rare in the Gippsland borings being sometimes the first specimen of *Lepidocyclina* to be recorded in bore sections.

Occurrence.—Upper Quarry, Australian Portland Cement Works, Batesford, near Geelong; New Quarry, Batesford; Green

Gully, Keilor; the upper portion of the Hamilton Bore, P. of Yulecart, Western Victoria; Flinders, Mornington Peninsula; and in various borings in Gippsland.

Form B.

Orbitoides mantelli Howchin (non Morton), 1891. In Hall and Pritchard, p. 10.

Lepidocyclina marginata Chapman (non *Nummulites marginata* Michelotti), 1910, p. 296, pl. iv., fig. 5; pl. v., figs. 1-3; Crespin, 1926, p. 115; 1936, p. 9.

Paratype.—External characters—Test large, discoidal, thin, biconvex, circular in outline. Numerous small pustules scattered over most of the unweathered test. Surface smooth towards periphery with lateral chambers frequently visible. Periphery rounded. Diameter—11 mm.; greatest thickness 2 mm.

Internal characters from tectotype.—Median section—Microspheric nucleoconch planispiral, showing circular arrangement of chambers in embryonic apparatus, which consists of a central initial chamber surrounded by six similar initial chambers arranged in a spiral. Arrangement of median chambers polygonal, showing 8 rays, as indicated in the megalospheric form. Rays do not extend to edge of test. Chambers surrounding embryonic apparatus and for some distance outwards, ogival in shape, passing into spatulate and elongate spatulate towards periphery. A few hexagonal shaped ones along outer margin.

Vertical section.—Horizontal median chamber thin in centre, widening out considerably towards each end of test. Sixteen superimposed lateral layers, only the outer five being continuous throughout the length of the test. The others rise gently convexly in central portion of test before converging to the central chamber. Lateral chambers thin-walled and straight-sided and do not alternate in their arrangement. A few pillars in centre of section.

Locality.—New Quarry, Batesford, near Geelong, collected by W. D. Chapman. (Com. Pal. Coll. No. 208.)

Another paratype.—Upper Quarry, Batesford (coll. F. A. Singleton). Test discoidal slightly biconvex. Surface free from pustules. Diameter—11 mm.

Observations.—This microspheric form was figured as *L. marginata* by Chapman (1910) who, at the same time, figured a megalospheric specimen. Douvillé (1904) states that only the microspheric form of *L. marginata* was known, but it is quite possible that *L. marginata* represented the microspheric generation of *L. tournoueri*. Chapman's figure (pl. liv., fig. 5) showing the megalospheric nucleoconch is referable to *L.* (*T.*) *batesfordensis*, fig. 2, representing the microspheric form of the same species.

The type median section of *L. marginata* shows it to be non-polygonal, while the outstanding feature of *L.* (*T.*) *batesfordensis* form B is its polygonal character.

In the upper quarry at Batesford, the several specimens available are all fractured but some idea of the diameter can be gathered, the variation being from 10 to 17 mm., the majority of specimens averaging 10 mm.

The rayed character of this microspheric form is exhibited in many species in the Netherlands East Indies. The strongly ogival shape of the median chambers in the vicinity of the initial apparatus together with the persistent spatulate shape of the later ones distinguishes the Victorian form from these in which hexagonal shaped chambers are predominant.

Occurrence.—Upper Quarry, Australian Portland Cement Co., Batesford, near Geelong; Green Gully, Keilor.

The Stratigraphical Position of the Lepidocyclina Horizon in Victoria.

The present investigation indicates that the *Lepidocyclina* horizon in Victoria can be divided into three zones. This zoning is supported by a close study of the Batesford section as represented in the New Quarry, where a systematic collection of material was made by F. A. Cudmore, and of bore sections at Hamilton and in Gippsland. The three zones are—(*a*) an upper one or *zone of L.* (*T.*) *batesfordensis*, which is characteristic of Batesford, where the assemblage is dominated by *Calcarina verriculata;* (*b*) an intermediate one or *zone of L.* (*T.*) *howchini*, typical of Hamilton, where *C. verriculata* is associated with *Hofkerina semiornata;* and (*c*) a lower one or *zone of L.* (*T.*) *gippslandica*, characteristic of Gippsland, where *H. semiornata* is common and *C. verriculata* exceedingly rare, with *L.* (*T.*) *batesfordensis* occurring very occasionally at the top of bore sec-sections. These zones will be more fully described at a later date.

Chapman (1910) made the first detailed study of the Victorian Lepidocyclinae in his work on the Batesford limestone, which led to the designation of the horizon as "Batesfordian." He recorded an assemblage of foraminifera, which, for the most part, is associated with all occurrences of *Lepidocyclina*. These forms are *Gypsina howchini, Planorbulinella plana, P. inaequilateralis* and *Calcarina verriculata*. In bores, none of these occurs above the horizon but the downwards range is extended somewhat. At Hamilton, *Hofkerina semiornata* is added to the assemblage, while in Gippsland it is very prominent but *C. verriculata* is exceedingly rare. On all occasions the above assemblage is associated with *Carpenteria proteinformis, C. rotaliformis, Amphistegina lessonii* and *Operculina victoriensis*.

Singleton (1941) considers the "Batesfordian" as a stage underlying the Balcombian, but evidence from numerous borings in Gippsland proves that it is a substage of that stage. The association of *Lepidocyclinae* with numerous mollusca referable to Balcombian species both at Hamilton in Western Victoria and at Skinner's in Eastern Victoria, the presence of the genus in Balcombian marls in the Tyabb bores, Mornington Peninsula, and its persistent occurrence in Balcombian bryozoal limestones, in subsurface sections in which no stratigraphic break is apparent, support this view.

Age of the Lepidocyclina Horizon in Victoria.

The fact that the orbitoidal foraminifera are of such importance in zoning marine Tertiaries beyond Victoria, makes the restricted occurrence here of utmost value in determining a precise age for the beds. When Howchin (1889) described the first orbitoidal foraminifera in Victoria from Hamilton, he referred them to the Eocene genus *Orbitoides,* and for this reason beds containing such forms were recognized as Eocene for some years. Lémoine and Douvillé (1904) placed them in Eocene to Miocene genus *Lepidocyclina.* Chapman (1910) considered the limestones at Batesford to be equivalent of the Burdigalian of Southern Europe and Middle Miocene in age, on account of his record of *L. tournoueri* and *L. marginata,* while he referred the beds at Clifton Bank, Hamilton, and at Keilor to "probably Upper Aquitanian" because of his record of *L. verbeeki,* a species which is found in the Lower and Middle Miocene in the Indopacific. Present evidence points to the Keilor beds being stratigraphically equivalent to those at Batesford, with the Hamilton ones slightly lower. Chapman and Singleton (1925) stated that "the predominant development of polyzoal limestones was in the Middle Miocene-Burdigalian or Batesfordian, the typical zone fossil being *Lepidocyclina tournoueri* or *L. martini* or both." Crespin (1926) referred to the age of the *Lepidocyclina* limestone at Keilor as equivalent of the Batesfordian. Chapman and Crespin (1932) described *Spiroclypeus,* a typical "e" stage (Lower Miocene) genus from a single specimen in a limestone from the Hamilton Bore and *L. radiata* Martin from Gippsland, a species listed as belonging to "e" stage in the Netherlands East Indies, while regarding the subgenus of all species as *Nephrolepidina.* Because of this determination of *Spiroclypeus,* all *Lepidocyclina*-bearing rocks in Victoria were considered to be of Lower Miocene age (Chapman and Crespin 1935). The result has been considerable confusion. Crespin (1936) stated that the determination of the Hamilton specimen as *Spiroclypeus* was incorrect, and it was found later that *L. radiata* apparently belongs to younger beds than the Lower Miocene in the Netherlands East Indies. Crespin still placed the Batesfordian in the Lower Miocene, but suggested

that the horizon would later prove to be younger in age, because of the absence of the typical " e " stage genera *Spiroclypeus* and *Eulepidina*, and the consideration that the subgenus of *Lepidocyclina* was *Nephrolepidina* which is typically lower to middle Middle Miocene. Singleton (1941) placed the horizon of the Batesfordian in the Lower to Middle Miocene at the same time elevating it to the position of a stage directly underlying the Balcombian. This classification was followed by Crespin (1941) in a report on the Holland's Landing Bore, Gippsland, the author stating that she agreed in the main with Singleton's sequence but placed the *Lepidocyclina* beds in the Middle Miocene.

The supposition, in 1936, that the Victorian Lepidocyclinae belonged to a younger age than Lower Miocene, was confirmed by investigations carried out with Dr. Tan Sin Hok in Java in 1939, the absence of true nephrolepidine Lepidocyclinae and the exclusive presence of trybliolepidine species indicating an horizon fairly high in the Miocene.

The Burdigalian species, *L. tournoueri* and *L. marginata*, are absent, the assemblage consisting entirely of rayed forms referable to the subgenus *Tryblioleipidina*, which is characteristic of the upper portion of the Miocene in the Indopacific region. *Miogypsina*, a common genus in the Miocene of the Netherlands East Indies, North-west Australia, Papua and New Guinea, is unrepresented. *Austrotrillina howchini*, which ranges from Lower to Middle Miocene in this region, occurs with *Lepidocyclina* in Gippsland and at Hamilton, the original specimen being described from the latter locality. As far as is known this form has not been recorded above the " f_2 " stage, in the Indopacific. The species of *Cycloclypeus* recently described from Gippsland (Crespin, 1941), have close affinities with this stage.

Evidence points, therefore, to the *Lepidocyclina* horizon in Victoria being not older than Middle Miocene with indications of being high in that part of the series. It is definitely not " e " stage, and is possibly referable to basal " f_3 " stage. In correlating it with European stages, it is higher than Aquitanian and is probably to be placed near the boundary between the Burdigalian and Vindobonian.

Acknowledgments.

My grateful thanks are due to Mr. F. Chapman, the first Commonwealth Palaeontologist, with whom I was at first associated in the work on this group of foraminifera; to the Director of the Geological Survey of Victoria and staff of the Mines Department for placing at my disposal all facilities for collecting material; to Mr. F. A. Cudmore, for making extensive collections from the Batesford quarries; to Mr. W. J. Parr and Dr. F. A. Singleton, for making material available; to Dr. Tan Sin Hok, of the

Geological Museum, Bandoeng, Java; and to Dr. M. Glaessner for helpful criticism.

Photographs of exterior of specimens were taken by H. B. Hawkins of the Minerals Resources Survey Branch and H. Gooch of the Geology Department, Sydney University, while micro-photographs were made by C. W. Brazenor of the National Museum, Melbourne, R. Millet of the Council for Scientific and Industrial Research, Canberra, and H. F. Whitworth of the Mining Museum, Sydney.

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Explanation of Plates.

Plate III.

Lepidocyclina (*Trybliolepidina*) *gippslandica* sp. nov.

Fig. 1.—No. 5 Bore, P. of Glencoe, Gippsland, at 70 feet. Form A. Holotype. No. 39. × 10. (After Crespin.)

Fig. 2.—No. 15 Bore, P. of Stradbroke, Gippsland, at 45 feet. Form A. Paratype. No. 93. × 10. (After Crespin.)

Fig. 3.—No. 15 Bore, P. of Stradbroke, at 45 feet. Form A. Paratype. No. 196. × 7.

Fig. 4.—Skinner's Section, Mitchell River, Gippsland. Form A. Paratype. No. 197. × 7.

Fig. 5.—No. 15, P. of Stradbroke, at 45 feet. Form B. Paratype. No. 198. × 7.

Fig. 6.—Brock's Quarry, P. of Glencoe, Form B. Paratype. No. 199. × 7.

Fig. 7.—Brock's Quarry, P. of Glencoe, Form B. Paratype. No. 200. × 7.

Plate IV.

Lepidocyclina (*Trybliolepidina*) *howchini* Chapman and Crespin.

Fig. 8.—Hamilton Bore, P. of Yulecart, Western Victoria, 80-85 feet. Form A. Holotype. No. 42. × 10. (After Crespin.)

Fig. 9.—Hamilton Bore, 48-53 feet. Form A. Paratype. No. 32. × 10. (After Crespin.)

Fig. 10.—Clifton Bank, Hamilton, P. of Yulecart, Western Victoria. Form A. Plesiotype. No. 201. × 8.

Fig. 11.—Hamilton Bore, 104-108. Form A. Paratype. No. 94. × 12. (After Crespin.)

Fig. 12.—Hamilton Bore, 80-85 feet. Form B. Plesiotype. No. 202. × 10.

Fig. 13.—Flinders, Mornington Peninsula. Form A. Plesiotype. No. 203. × 8.

Fig. 14.—Flinders, Mornington Peninsula. Form A, showing strong pustules. Plesiotype. No. 204. × 8.

Fig. 15.—Flinders, Mornington Peninsula. Form B. Plesiotype. No. 205. × 8.

Plate V.

Lepidocyclina (*Trybliolepidina*) *batesfordensis* sp. nov.

Fig. 16.—New Quarry, Batesford, near Geelong. Form B. Paratype. No. 206. × circ. 6.

Fig. 17.—Upper Quarry, Batesford. Form B. Paratype. No. 207. × 6.

Fig. 18.—Upper Quarry, Batesford. Form A. Holotype. No. 208. × circ. 7.

Fig. 19.—Upper Quarry, Batesford. Form A, showing fractured specimen. Paratype. No. 209. × circ. 9.

Fig. 20.—New Quarry, Batesford. Form A. Paratype. No. 210. × 8.

Fig. 21.—No. 7 Bore, P. of Colquhoun, Gippsland, at 480 feet. Paratype. No. 211. × 7.

Plate VI.

Lepidocyclina (*Trybliolepidina*) *gippslandica* sp. nov.

Fig. 22.—No. 5 Bore, P. of Glencoe, Gippsland, 70 feet. (Locality of Holotype.) Median section. Form A. Tectotype. No. 212. × circ. 20.

Fig. 23.—Embryonic and nepionic apparatus of Fig. 22, showing protoconchal and deuteroconchal chambers, two primary auxiliary and five adauxiliary chambers. × circ. 40.

Fig. 24.—Vertical section of specimen from same locality. Tectotype. No. 213. × circ. 20.

Fig. 25.—No. 1 Bore, Pt. Addis (Metung), P. of Bumberrah, at 872 feet. Median section. Form A, showing only three nepionic chambers. Tectotype. No. 214. × 17.

Fig. 26.—Vertical section of specimen from same locality. Tectotype. No. 215. × 14.

Fig. 27.—Embryonic and nepionic apparatus of another specimen from No. 5 Bore, P. of Glencoe, 70 feet, showing protoconchal and deuteroconchal chambers, two primary auxiliary and five adauxiliary chambers. Tectotype. No. 216. × 82.

Fig. 28.—No. 15 Bore, P. of Stradbroke, Gippsland. Vertical section. Form A. Tectotype. No. 217. × 17.

Fig. 29.—No. 15 Bore, P. of Stradbroke, at 45 feet. Median section of Form B, showing rayed character of central portion. Tectotype. No. 218. × 15.

Plate VII.

Lepidocyclina (*Trybliolepidina*) *howchini* Chapman and Crespin.

Fig. 30.—Hamilton Bore, P. of Yulecart, Western Victoria, 86-91 feet. Median section. Form B. Specimen ironstained. Tectohypotype. No. 219. × circ. 15.

Fig. 31.—Hamilton Bore, 36-38 feet. Vertical section. Form B. Specimen ironstained. Tectohypotype. No. 220. × 14.

Fig. 32.—Clifton Bank, Hamilton. Median section. Form A, showing embryonic and nepionic apparatus, showing protoconchal and deuteroconchal chambers, two primary auxiliary and six adauxiliary chambers, surrounded by ogival-shaped chambers. Tectohypotype. No. 221. × 53.

Fig. 33.—Hamilton Bore, 80-85 feet. (Locality of Holotype.) Median section. Form A. Tectotopotype. No. 222. × 14.

Fig. 34.—Hamilton Bore, 45-53 feet. Vertical section. Form A. Tectohypotype. No. 223. × 17.

Fig. 35.—Hamilton Bore, 80-85 feet. Median section. Form A. Tectotopotype, No. 224. × 14.

Plate VIII.

Lepidocyclina (Trybliolepidina) batesfordensis sp. nov.

Fig. 36.—Old Filter Quarry, Batesford, near Geelong. Embryonic and nepionic apparatus of Fig. 37, showing two primary auxiliary and six adauxiliary nepionic chambers. Tectotype. No. 225. × 120. (Photo by Dr. Tan Sin Hok.)

Fig. 37.—Same locality as Fig. 36. Median section. Form A. Tectotype. No. 225. × 14.

Fig. 38.—Upper Quarry, Batesford, near Geelong. (Locality of Holotype.) Median section. Form A. Tectotype. No. 226. × 8.4.

Fig. 39.—Nepionic apparatus of Fig. 38, showing eight adauxiliary nepionic chambers. Tectotype. No. 226. × 36.5.

Fig. 40.—Upper Quarry, Batesford. Median section. Form A. Tectotype. No. 227. × 8.

Fig. 41.—Same locality. Vertical section. Form A. Tectotype. No. 228. × 14.5.

Plate IX.

Lepidocyclina (Trybliolepidina) batesfordensis sp. nov.

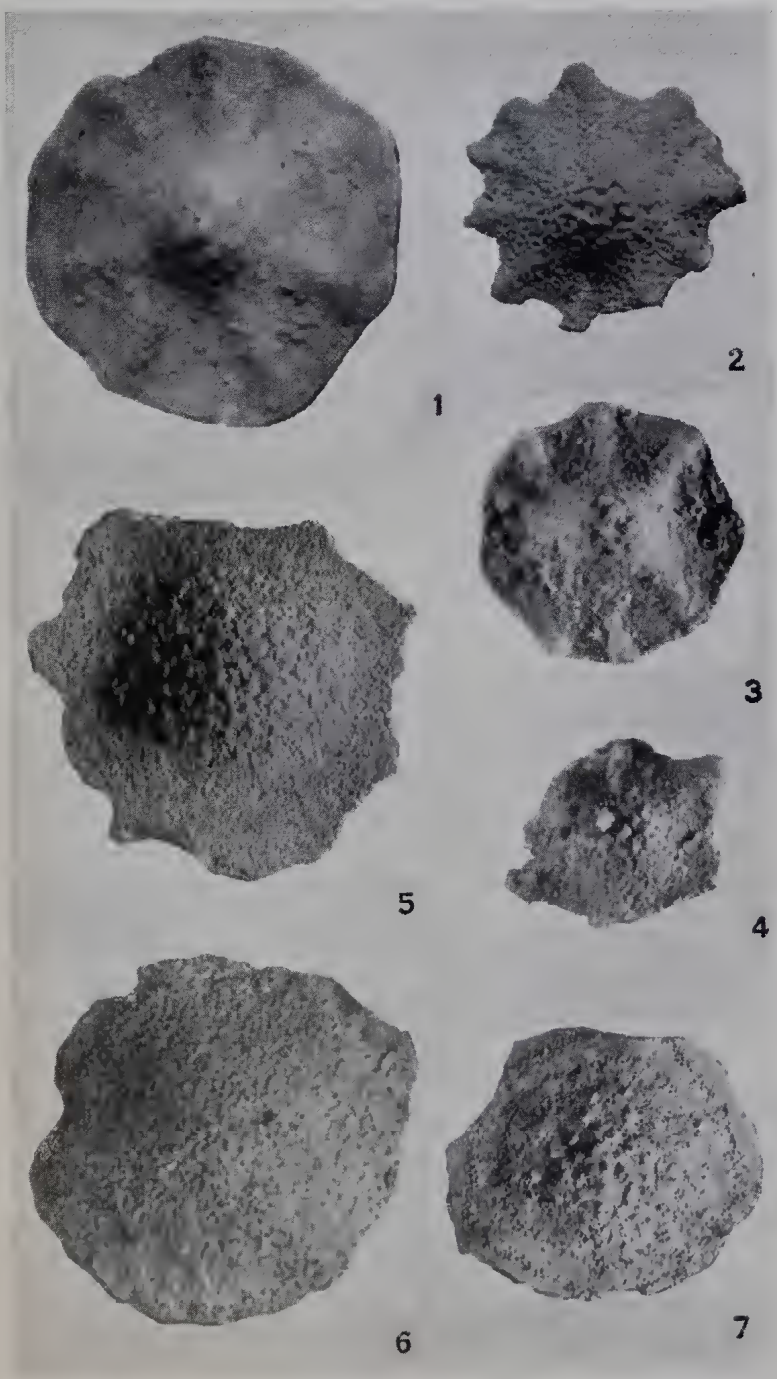
Fig. 42.—Upper Quarry, Batesford, near Geelong. Median section. Form B. Tectotype. No. 229. × 7.5.

Fig. 43.—Upper Quarry, Batesford. Vertical section. Form B. Tectotype. No. 230. × 7.5.

Fig. 44.—Old Filter Quarry, Batesford. Median section. Form B. Tectotype. No. 231. × 16.

Fig. 45.—Same locality as Fig. 45. Median section. Form A, showing eccentric protoconchal chamber. Tectotype. No. 232. × 50.

Fig. 46.—*L.* (*T.*) *gippslandica* sp. nov. No. 1 Bore, Pt. Addis (Metung), P. of Bumberrah. Median section, showing eccentric growth in deuteroconchal wall. Tectotype. No. 233. × 44.



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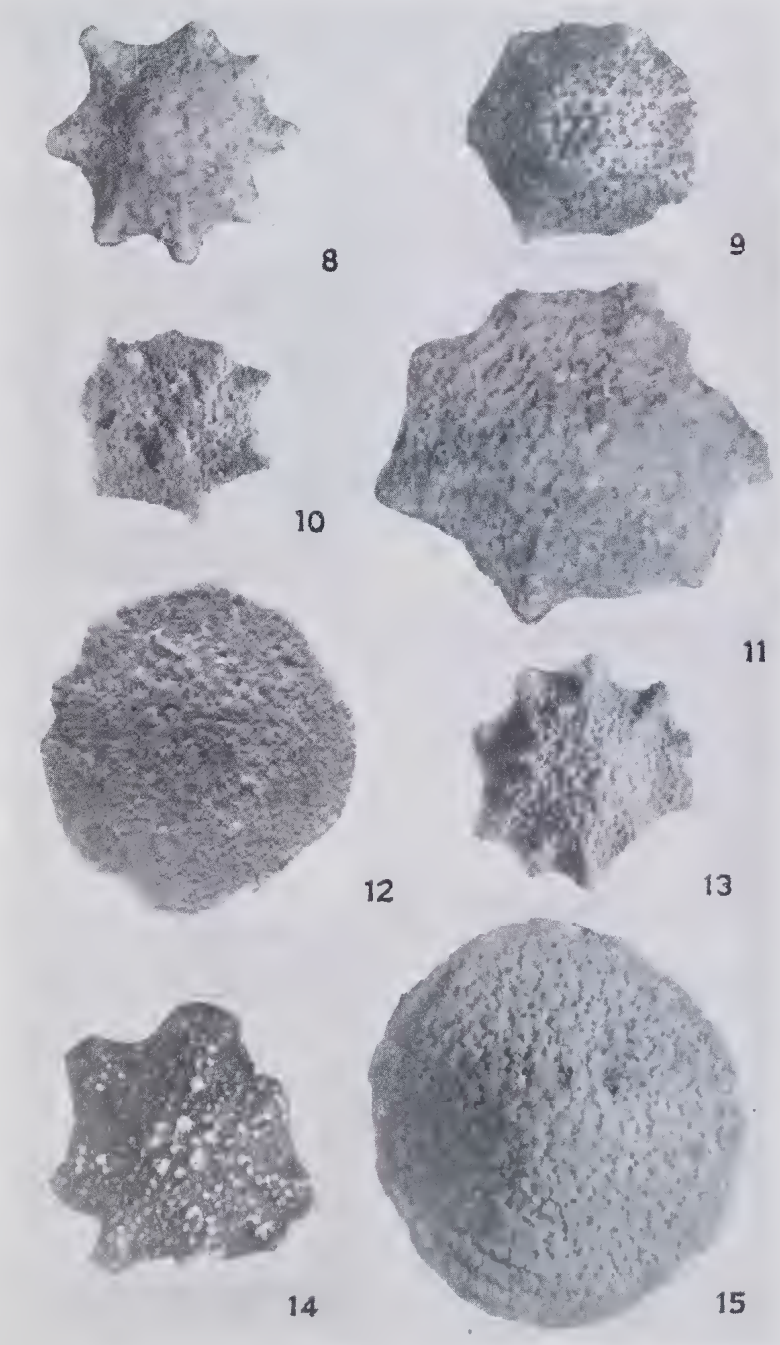

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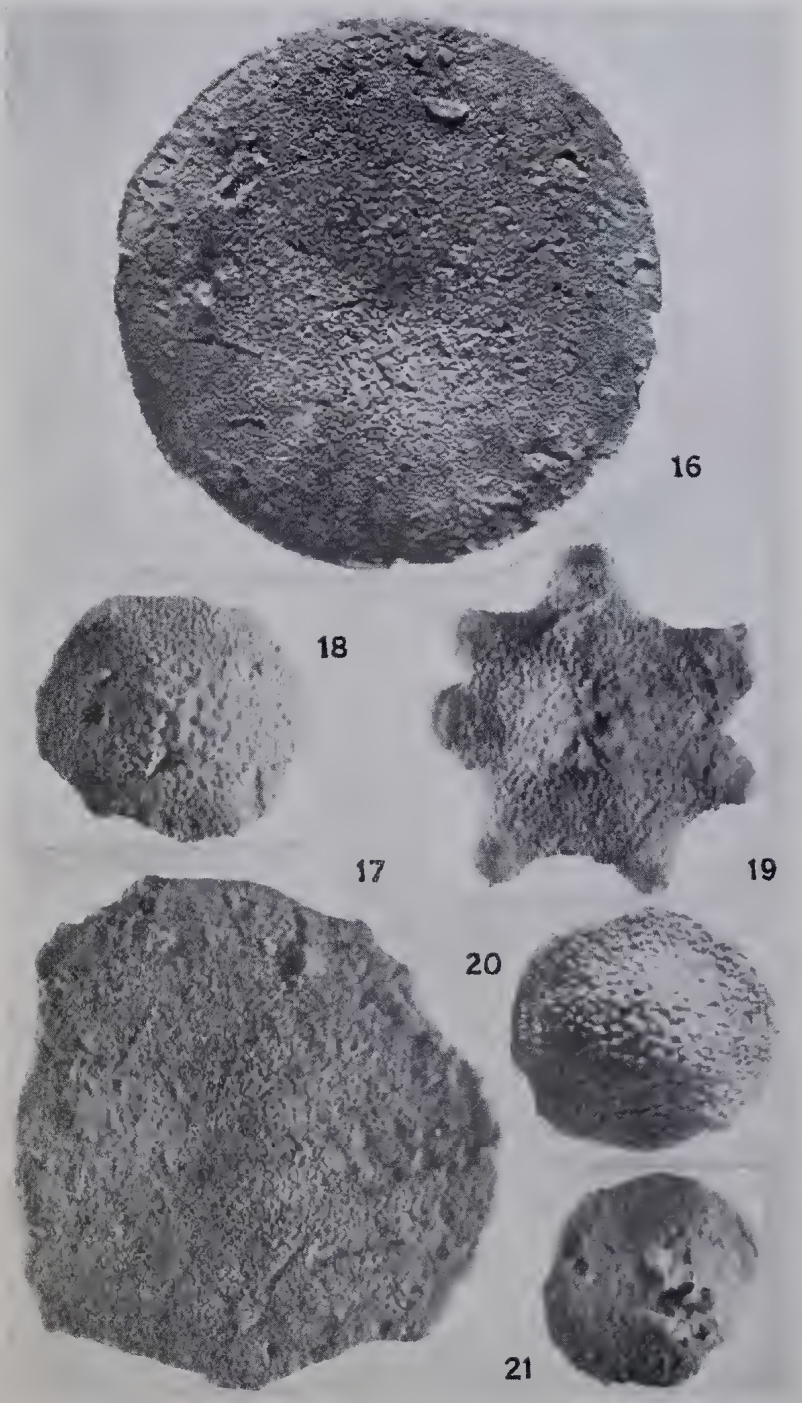

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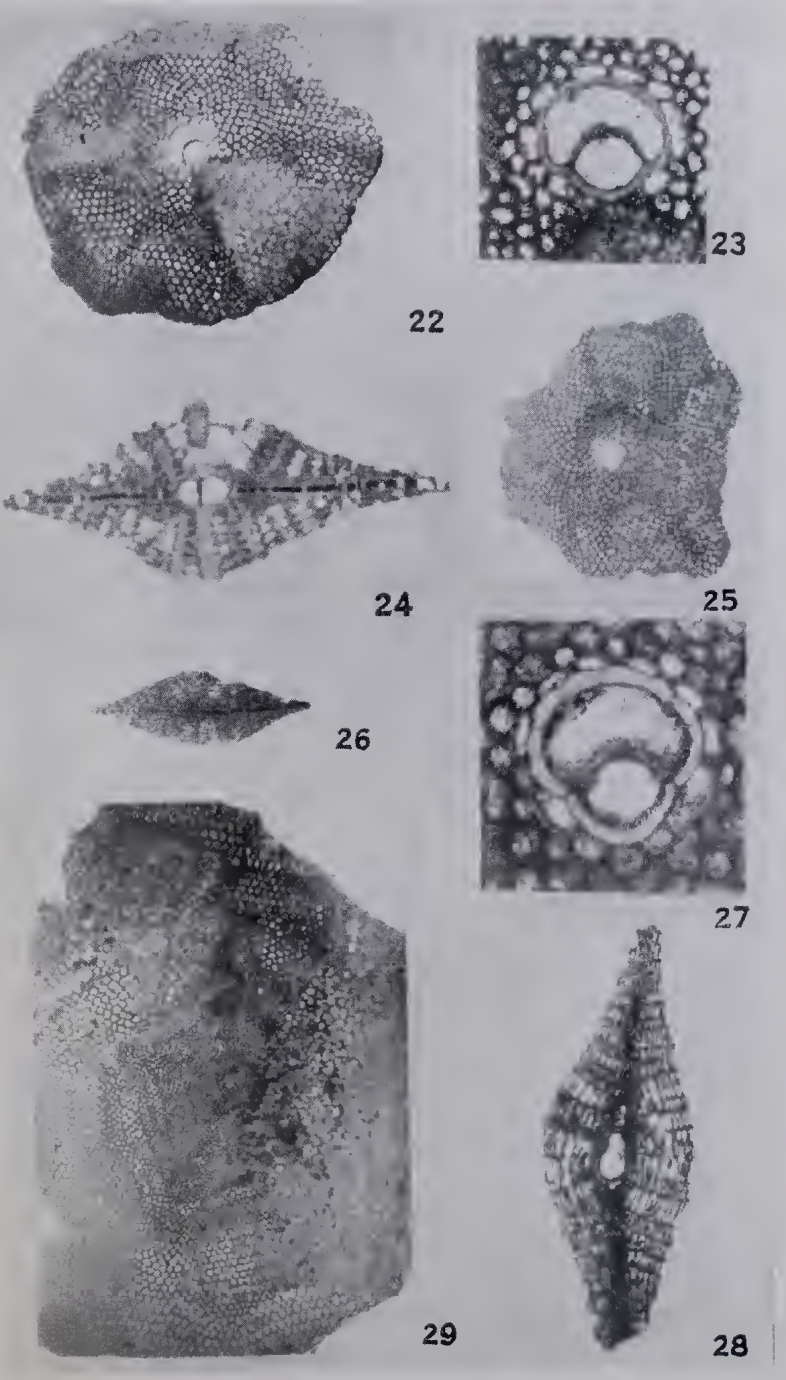

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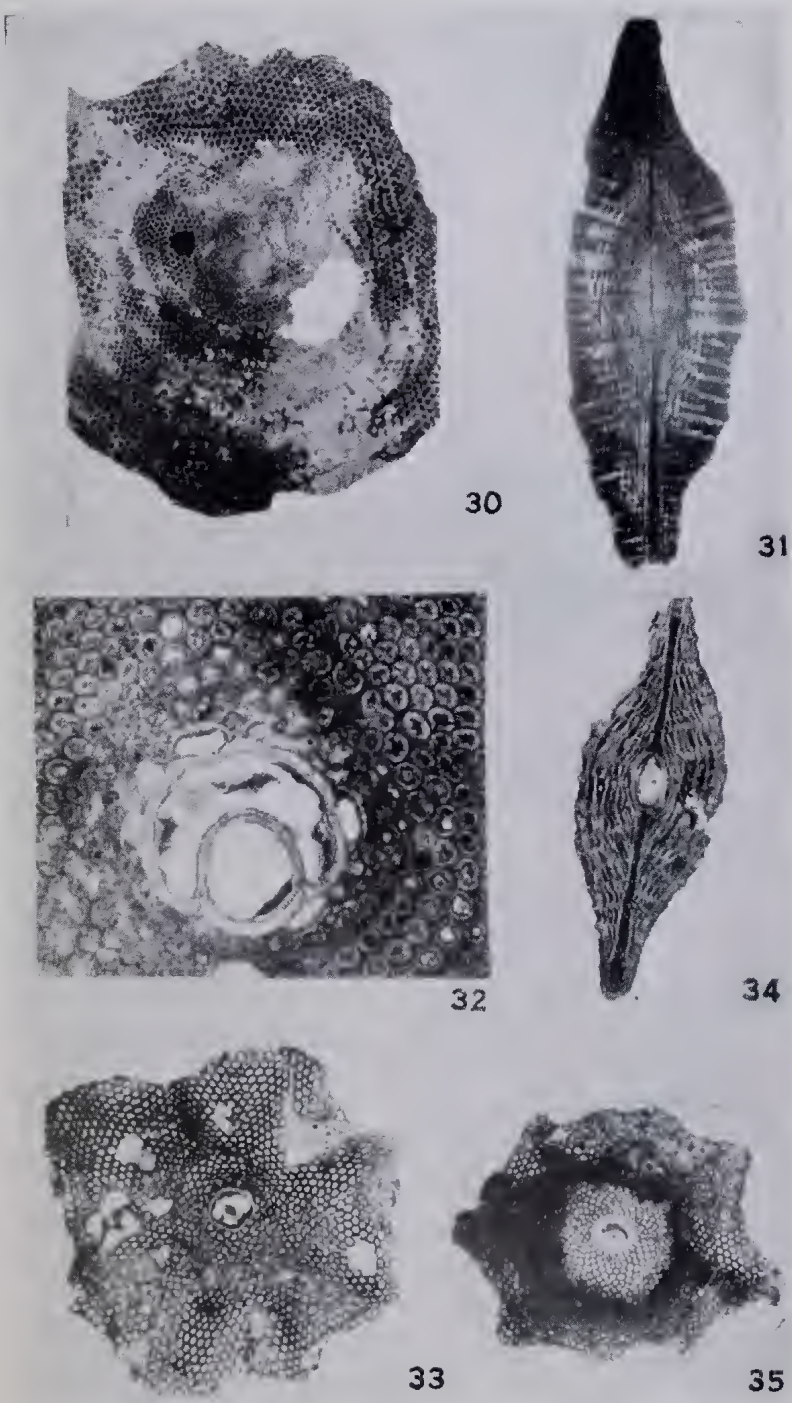

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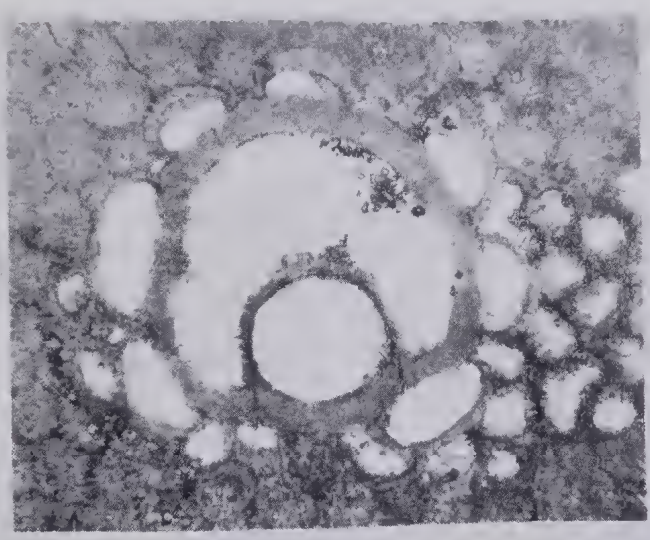

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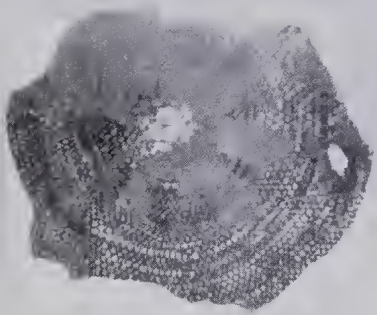

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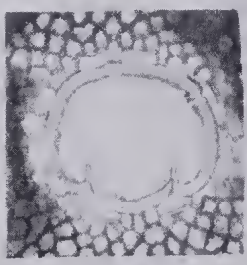

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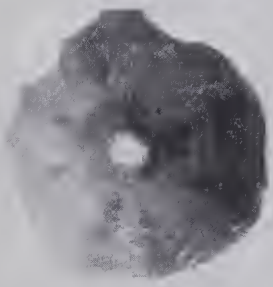

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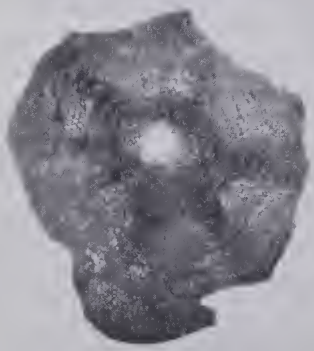

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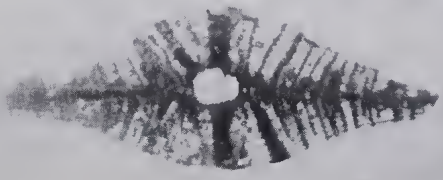

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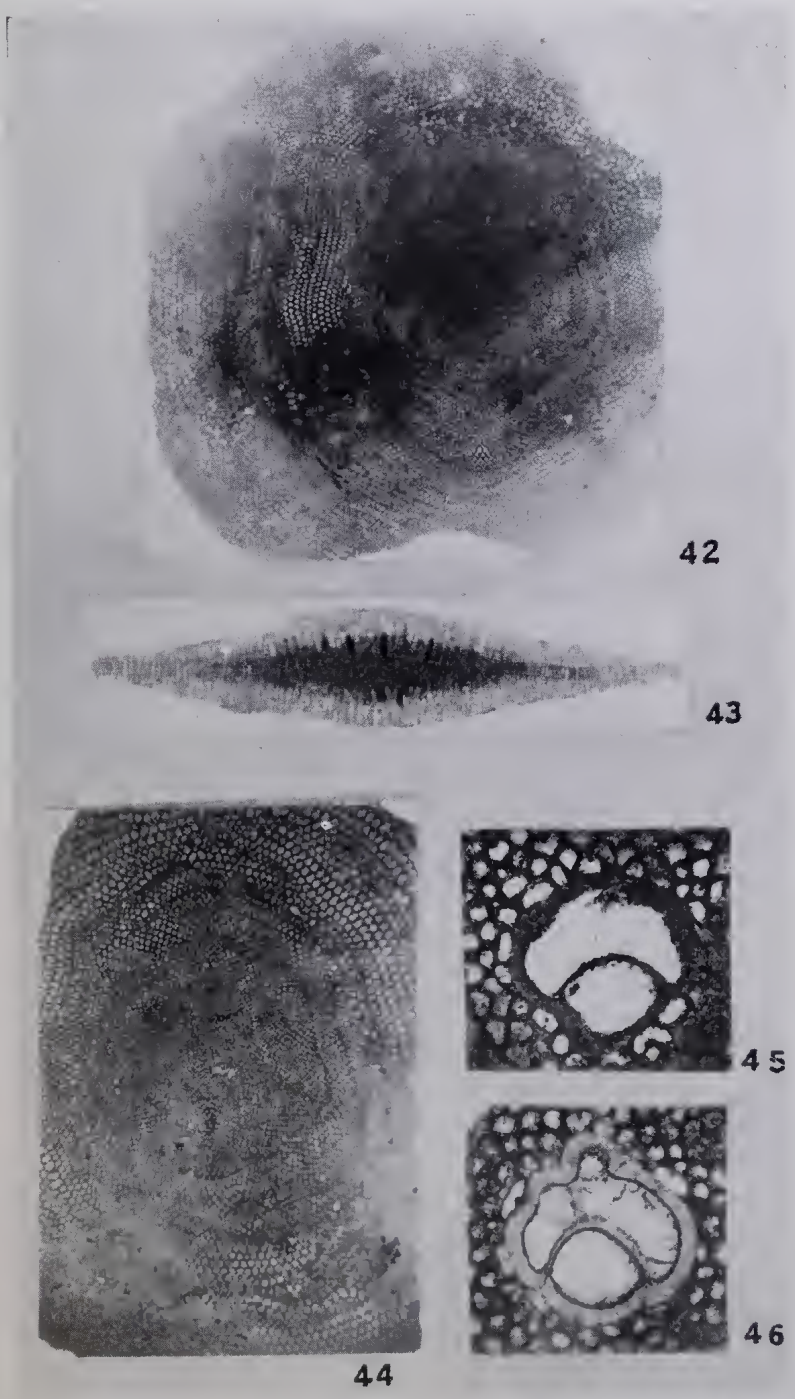
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